# UI OF MIAMI SEA GRANT PROGRAM



## Benefit Cost Analysis of Alternative Expansion Sites for the Virginia Key Sewage Treatment Plant

LEE G. ANDERSON

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# FOREWARD

The Sea Grant Colleges Program was created in 1966 to stimulate research, instruction, and extension of knowledge of marine resources of the United States. In 1969 the Sea Grant Program was established at the University of Miami.

The outstanding success of the Land Grant Colleges Program, which in 100 years has brought the United States to its current superior position in agricultural production, was the basis for the Sea Grant concept. This concept has three objectives: to promote excellence in education and training, research, and information services in the University's disciplines that relate to the sea. The successful accomplishment of these objectives will result in material contributions to marine oriented industries and will, in addition, protect and preserve the environment for the enjoyment of all people.

With these objectives, this series of Sea Grant Special Bulletins is intended to convey useful research information to the marine communities interested in resource development.

While the responsibility for administration of the Sea Grant Program rests with the Department of Commerce, the responsibility for financing the program is shared by federal, industrial and University of Miami contributions. This study, Benefit Cost Analysis of Alternative Expansion Sites for the Virginia Key Sewerage Treatment Plant, is published as a part of the Sea Grant Program.

# BENEFIT COST ANALYSIS

# OF ALTERNATIVE EXPANSION SITES FOR VIRGINIA KEY SEWERAGE TREATMENT PLANT

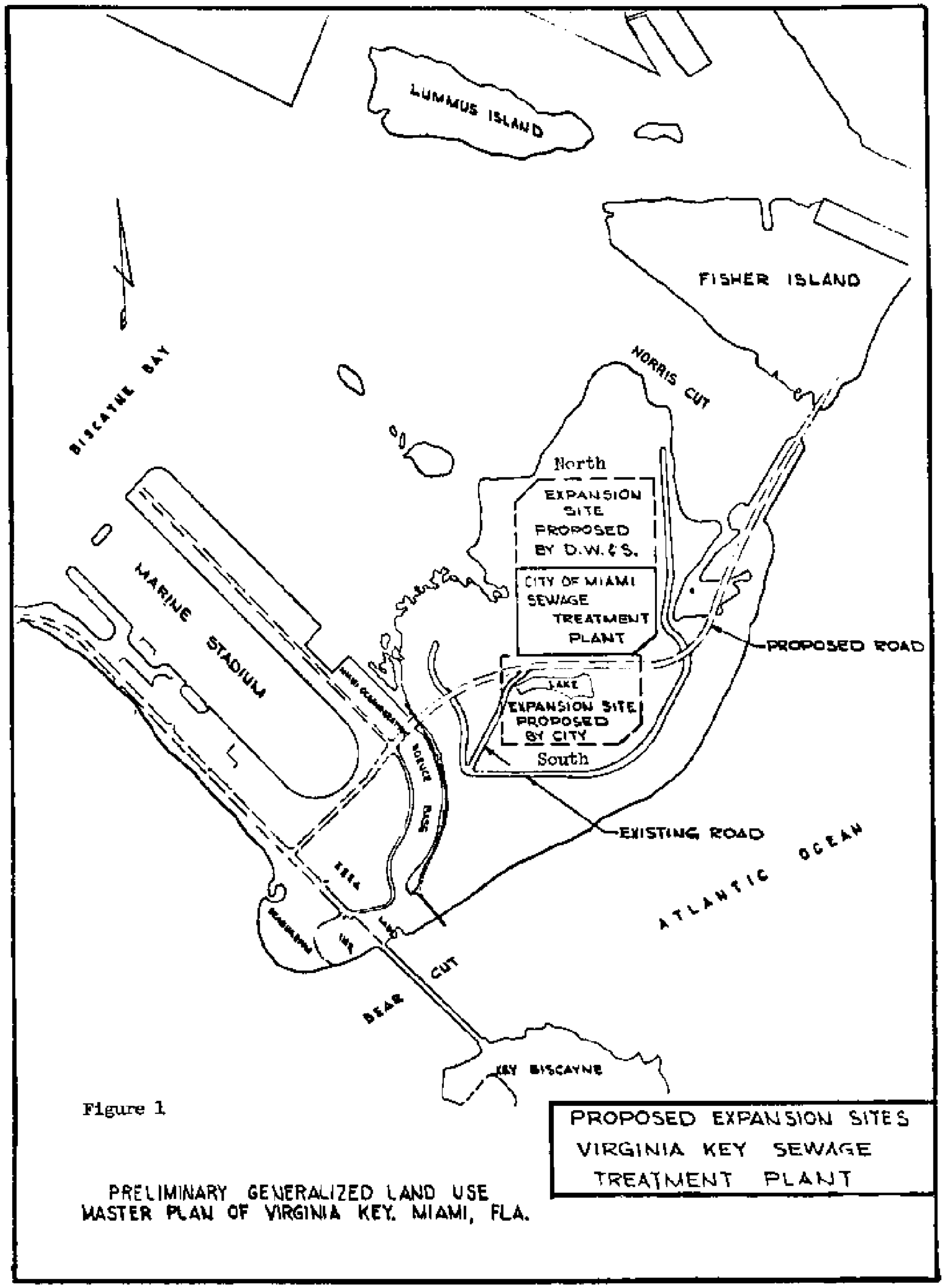


Figure 1

## Introduction

The following is from the Miami Herald of July 27, 1971.

"Miami's Virginia Key sewage treatment plant will be expanded as much as is necessary to treat central Dade's sewage, Miami commissioners have decided --- over the strenuous objections of City Manager Melvin L. Reese.

The plant's size might have to be doubled by the year 2000 gobbling up 65 more acres of the valuable public land on the central Biscayne Bay key, according to Water and Sewer Director Garrett Sloan.

Left open is the question on the direction in which the plant will be expanded, a question certain to bring about more heated debate."

The purpose of this paper is to address that very question. Figure 1 is a drawing of Virginia Key showing the position of the existing sewage treatment facilities and the two proposed expansion sites, the northern site and the southern site. Since the operational effectiveness of the plant at either site will be the same, the problem is to find the site which entails the lowest overall costs. The overall cost at each site consists of the construction costs plus the opportunity cost of the land. The definition and measurement of the former is straightforward, but both definition and measurement of opportunity cost is somewhat more difficult.

Opportunity cost can be defined as the benefits or the value derived from using the land in its next best use. Because local planning agencies have designated Virginia Key for recreational use, for the purposes of this study opportunity cost will be measured in terms of recreational opportunities foregone.

Technically this opportunity cost is the present value of the stream of yearly recreational benefits minus the present value of the cost of providing the facility. The equation for the present value of a stream of benefits is:

$$PVB = \sum_{i=1}^{n} \frac{B_i}{(1 + r)^i}$$

where $B_i$ is the net benefit for the ith year of life of the project, n is the length of life, and r is the rate of interest. For example, if the gross value of the services of a certain project in its fifth year of operation is $3,000 and the cost of operating it for that same year will be $500, the net value of the services provided will be $2,500. If the interest rate or the rate of discount is 5% then dividing $2,500 by $(1.05)^5$ (1.2762) will result in the present value of the $2,500, five years from now. This amount is $1,958. Looked at another way, if $1,958 is put in a savings account that earns 5%, at the end of five years it will be worth $2,500.

The present value equation is just the sum of this discounted benefits over the life of the project. By making use of it, it is possible to place a single value on a multi-yeared project. This makes it possible to compare this value with the cost of building the project and also with the present value of other projects. The problem, of course, is in measuring the yearly benefits and in selecting the proper rate of discount. The latter can be overcome to a large degree by using several rates to determine if a change in the rate has a significant effect on the results.

Description of the two sites

An expansion to the south would be built on a site that is marshy and has been the site of a solid waste disposal dump and therefore would be more expensive than an expansion to the north. Specifically, construction costs in the south would be $21 million, while in the north it would



be $20 million. This site also has some drawbacks as a recreational area; it is located a good distance from the water and the rough terrain and the previous use of the site as a dump would make it fairly expensive to turn it into a recreational facility. It might also be noted that if the expansion were to be built here it would more than likely have little effect on the use of the existing beach on the east side of the island since the two would be separated by a road and a "green strip."

The site to the north is more suitable for the construction of the expansion and also for conversion to a recreational facility. A recreational project built on this site would have access to a fine potential beach area along the eastern side and northern tip of the island. The western side does not have a sandy beach and so could not be used as a swimming site as such. Expansion of the plant to the north would just about completely destroy this area for possible water recreation use either by taking over the land or by significantly cutting down access to it.

It might be argued that the northern site would be the best for the plant since it is the furthest away from other users of the Key such as the Seaquarium, the Marine Stadium, and the oceanic research complex. This is more than likely a weak argument since in those cases where the workload of the plant and the wind conditions combine to send obnoxious odors towards these places (an unusual event), a mean locational difference of 800 yards will be significant only part of the time.

From the above it can be seen that the problem essentially boils down to the following: Assuming that the cost estimates are accurate expansion of the sewage plant at the southern site will mean higher construction costs but will allow for the construction of recreational facilities with access to the water while expansion at the northern site will mean lower construction costs but will only allow for land based recreation. The relevant question is: Is access to the water for the recreation facility worth the extra one million dollars in construction costs? In terms of the above discussion of opportunity costs, this question can be stated as "Is the opportunity cost of using the northern site which has access to the water equal to a million dollars more than that of the site to the south which does not?" If so, then the overall cost of both which includes construction costs and opportunity costs, are equal.

The answer to the above question depends upon what type of recreational use is considered and how much additional value that use will have if there is access to water. Two types of recreation activities will be considered: an overnight campground facility and a day picnic facility.

Use of the Land as an Overnight Campground Facility

A campground with 750 campsites can be built on either site for about $2.725 million. Assuming that the use of such a campsite for one night is worth $7.00, (this is about halfway between the $3.00 charged at other Florida government owned parks and the $11.00 charged at Disneyworld) if there is a yearly attendance of 50% capacity then such a park would generate $703,125 a year after operating expenses have been deducted. (See Appendex 1 for raw data on these figures.) The present value of twenty years of such operation discounted at 6% is $8.09 million.

The net benefit from this use of the land is the present value of benefits minus the construction costs or $8.09 million - $2.725 million which is $5.365 million. This would be the opportunity cost of using the land for some other purpose.

The above does not take into account the extra value of having a campsite with access to the water. If that information were available it would be a simple matter to find the increase in opportunity cost that would be provided by access to the water, and then there would be some basis for



deciding between expansion to the south or to the north. Unfortunately, such information is not available and so an alternate method of analysis must be used. It can be shown, for instance, that if the admission price for a water based campsite were $7.64 the opportunity cost of the land would increase from $5.365 million to $6.365 million.

This means that at the 6% discount rate and the stated assumptions about attendance figures, if people are willing to pay $.64 more per campsite over a twenty year period is enough to make up for the extra one million dollars in construction costs.

If people are willing to pay more than an $.64 extra for the water then clearly construction to the south has the lower total overall cost since the opportunity cost of access to the water would be more than one million dollars.

It should be pointed out that it is not necessary that these campers be forced to pay this extra amount for these figures to make sense. Whether they pay or not, there is still a net benefit since people are being provided with a service that is worth more than it costs.

Since it is very difficult to select the proper discount rate and yet the discount rate is an important variable, it is useful to analyse the change in conclusions that result from changes in discount rates. It is also interesting to see how changes in assumptions about starting dates and about lengths of life of the project can affect them. The longer the life the larger is the number of years over which the yearly benefits can be added. But because the future is very uncertain, it is usually folly to count benefits too far into the future. The starting date of a project can also be important because the further in the future it is, the more its yearly benefits must be discounted.

To take these things into consideration, four different campsite projects were studied, each at five different discount rates. The first two start immediately with one running twenty years and the other running ten. The others are each of ten years duration with one of them starting five years and the other ten years in the future. In all cases, construction costs were considered to be \$2.725 million on the grounds increasing it by the annual inflation rate and then discounting back to a present value will not significantly change its value.

Table 1 is a summary of the results of computations using the different discount rates and assumptions about the life of the project and its proposed starting date. In each part of the table, the row labeled PVB contains the present value of the benefits, the row labeled NB contains the net benefit of the project which is PVB minus \$2.725 million for construction costs, and the row labeled $P_1$ contains the increase in price for the water based project necessary to make the overall costs of expanding to the north and to the south the same. (The meaning of the row labeled $P_2$ will be explained later.) For example, in the 20 year project, a higher discount rate of 14% and the same attendance rates will mean that the present value of the benefits is \$4.653 million. The net benefit is \$1.928 million and people must be willing to pay \$1.09 more than the specified \$7.00 for a campsite with access to the water in order to make the opportunity cost of building to the north high enough such that overall cost for both sites are equal.

Those figures in the NB row that are negative represent projects and interest rates where the present value of benefits is less than the construction costs. For example, the ten year project that starts ten years from now has a present value of benefits of \$1.664 million when the discount rate is 10% which means the net benefits will be \$-1.061 million. The \$10.25 in the parenthesis in the $P_1$ row is the admission price that would be necessary in order for the net benefits to be equal to zero, and \$3.08 is extra payment necessary in order for the net benefits to be equal to one million dollars to balance off the difference in construction costs.



A good case can be made that in all of the above the opportunity cost of using the area to the south is really zero on the grounds that there are many spots on the mainland where such a land based camping facility could not be built. Many possible sites exist. This is not the case for the water based recreation facility in the north, however. There are really very few undeveloped sand beaches available in Dade County. Therefore, if the plant is expanded to the north, the possibility of constructing a camp ground with access to water is in fact eliminated.

If one accepts this, then it is only necessary that the opportunity cost of the northern site be at least equal to one million dollars in order to justify the extra costs of building to the south. The price that people must be willing to pay for this to be the case for the various projects is listed in the rows labeled $P_2$ in the various parts of Table 1. For example, in the twenty year project, if the discount rate is 6%, then people must be willing to pay \$4.22 per campsite in order for the net benefit of the project to be one million dollars.

Use of the Land as a Picnic Facility

Deriving the net benefit from the use of the land as a picnic facility is more difficult than doing so for a camping facility because it is very difficult to get a good proxy for people's willingness to pay. It is easy however, to show how much this willingness to pay must be in order for benefits to at least be equal to costs. This is one approach that will be used here.

A picnic facility with parking spaces and tables sufficient for 500 parties can be built on either site for around \$650,000. (See appendix 2.)

At 50% of capacity this will provide 310,250 recreation days per year. Since this is only 3% of the visitors at Cape Florida, Crandon Park, and Virginia Key Park, and because of the rapidly increasing population of the south Dade area, it is not unreasonable at all to assume that such a facility, if built, would in fact have such a yearly attendance figure.

Assuming a twenty year life span and a discount rate of 6% if each visitor has a willingness to pay of $0.60, the benefits of the project would just equal the costs. Or to put it another way, if the value of the recreation service is $0.60 per person, the benefits are equal to costs. (See appendix 2 for the assumptions concerning operating costs and an equation for deriving this price.) If the people are willing to pay $0.88 per person then there will be a net benefit of one million dollars. This means that if people are willing to pay $0.28 more for a picnic site near the water than they are for one that is not, and if the total they are willing to pay is $0.88 or more then it makes sense to build the sewer expansion to the south so as to leave open the option of water based recreation. This is because the extra benefits derived from having the picnic facility near the water makes up for the extra $1 million in construction costs necessary to build the expansion to the south thus leaving the northern part of the island available for the picnic facility.

This is, of course, not a proof that the expansion should be built in the south, but since these figures are so small it certainly means that solid consideration should be given to such a course. That is, there is no proof that people are willing to pay these amounts, but the figures do not sound at all unreasonable. If they are willing to pay that much or more then the wisest use of public funds would be to build the treatment plant in the south and a picnic area with access to the water in the north. The gain the people would get from using the recreation facility would more



than make up for the extra construction costs.

The minimum willingness to pay for benefits to equal costs or for net benefits to equal to $1 million will differ with different assumptions about the rate of interest and the life of the project. Table 2 is a summary of how these things change with different assumptions. $P_3$ is the price necessary for benefits to equal costs and $P_4$ is the additional money people must be willing to pay for access to the beach in order for the net benefit of the project to equal the one million in extra construction costs. For example, if the recreation facility will not be built for five years and an 8% discount rate is used, each individual visitor would have to be willing to pay $0.84 in order for benefits to equal costs and $1.49 in order to yield a net benefit of one million dollars. This means that if people are willing to pay $0.65 extra for a picnic site near the water and if they are willing to pay $1.49 or more in total then the sewer expansion should be built to the south.

Remember that by willingness to pay, it is meant that people will receive that much value from the experience. It has been the tradition in the United States for such recreation facilities to be operated free of charge by various agencies of the government, and so some people may have an aversion to paying entrance fees but this does not mean that they do not receive a value when the service is provided to them. This discussion in no way implies that these people should be charged an entrance fee (although there may be some arguments in favor of such a proposition). That is a matter of equity. Regardless of who pays for it, the recreationists or the government, services of these values are being produced and distributed to the consuming public.

Although it would be very difficult to estimate the value of a picnic experience with and without accessibility of water, the water resources council of the United States Government (1971) have put out some standards that might shed some additional light on the problem. They suggest that the value of a recreation day for such things as swimming, boating, picnicing, etc. ranges from $0.75 to $2.25. It is left up to the general researcher to decide which value in this range to choose. In a critique of these standards Cichitti et al., (1971) state "..., the principles and standards must specify that lower values in these ranges be used when alternative uncongested recreation areas (whether public or private) serve the same populations as the proposed project or reserved water resources. If alternative areas are either non-existent or overcrowded, the higher values should be utilized to evaluate benefits;..."

Because of the fact that uncrowded beach areas or potential beach areas are relatively more scarce than picnic areas or potential picnic areas and also because it would seem that the availability of beach would make the recreation experience more valuable, let us assign a value of $2.25 to a recreation day at a facility built to the north of the present treatment plant, since it has access to water and $0.75 to one at a facility built to the south since it does not.

Using these figures and again assuming 310,250 visitors per year for twenty years and a discount rate of 6% the present value of the benefits from a recreational facility on the northern site is $6.538 million while the benefits of one on the southern site is $1.181 million. Given the $650,000 construction cost of each, the net benefit from using the land to the north for recreation is $5.888 million while the net benefit of the land to the south is only $.531 million. This means that the overall cost of building to the north is $20 million construction costs plus $5.888 million opportunity cost of $25.888 million. The overall cost of building to the south is $21 million construction costs plus $.531 million opportunity costs or $21.531 million total. Therefore, it makes sense to build to the south. This is especially true when it is highly likely that the true opportunity cost of building to the south is zero since there are many other possible sites for land based recreational facilities.



Table 3 is a summary of different calculations similar to the one described above except that different discount rates and starting times for the program are used. For example, with a discount rate of 10% the 10 year project starting immediately will have a net benefit of $.759 million if it is built in the south and $3.553 million if built to the north.

It is interesting to note that in all cases the net benefit of the recreation project in the north is more than a million dollars greater than the one in the south, which means regardless of the assumptions concerning length of life of the project, starting time of project, or rate of discount, it always makes more sense to build the expansion of the sewerage treatment plant to the south. Also note that the project with access to the water always has a positive net benefit, but this is not always true for the land locked facility.

Summary

The above information should be very useful in making the final decision about where to locate the expansion of the sewer plant. Whether a camping facility or a day beach is provided, under all but the strictest assumptions about starting time for the recreation facility and the size of the discount rate, it appears reasonable that the benefits that would be gained by leaving the north open for recreation purposes would more than outweigh the extra one million dollars in construction costs necessary to expand to the sewer to the south. If the recreation facility will never be built or will not be built until far into the future, then this will not be true. But these figures indicate that these facilities should be built as soon as possible.

Perhaps a word is in order about which type of recreation facility should be built. Even though the camping facility has a higher net benefit, I would think that the picnic-beach operation should be built because most of the net benefit that is derived from the campsite could be gained even if it were built away from the water. Only that extra part of it that is due to the nearness of the water is what we are concerned with. Also the prime users of such an operation would be tourists traveling through and not citizens and taxpayers of this area. Therefore the local government should not be the one that should provide this type of facility. On the other hand, local residents will make great use of a beach and to build a beach you must have access to the bay.



Appendix 1

Information on Cost of Constructing Campsite Facility

1. Cost common to both

   75 acres with 10 campsites

   per acre at $35,000 per acre* = $2.625 million

   Cost unique to North

   road = $100,000

   Cost unique to South

   extra landscaping = $100,000

   TOTAL COST of either $2.625 million + .1 million = $2.725 million

2. Revenues

   .50% capacity* at $7.00

   .5 x 750 x 365 x 7.00 = $958,125

3. Yearly operating expenses

   $3,400** an acre

   This is overestimated because it is average

   3,400 x 75 = 255,000

4. Net revenue

   Revenue - operating cost = $703,000

5. Equation for deriving $P_1$ in Table 1

$$P_1 = \frac{1}{.136875} \left(\frac{1}{X}\right) = 7.305 \left(\frac{1}{X}\right)$$

Where .136875 is the expected attendance in millions and $X = \sum_{i=M}^{n} \frac{1}{(1+r)^M}$, r is the interest rate, M is the starting date of the project and n is the end of projects useful life, for purposes of this study in years from present.

When the net benefits are zero the expression for deriving the price in parenthesis is

$$\frac{1}{.136875} \quad \left( \frac{2.725}{X} + .255 \right)$$

6. Equation for deriving $P_2$ in Table 2

$$P_2 = \frac{1}{.136875} \quad \left( \frac{3.725}{X} + .255 \right)$$

Where .255 is operating expenses in millions.

*Estimated with the help of:
Robert Perkins
Chief
Research Department
Dade County Parks

**Estimated with the help of:
William Talbert
Research Department
Dade County Parks



Appendix 2

Cost information on Public Facility

1. *Construction cost

| | |
|---|---|
| Cost common to both: | |
| Parking | |
| 500 cars at $100 a car | = $50,000 |
| Restrooms | |
| 2 at $40,000 | = 80,000 |
| Picnic Tables | |
| 500 at $50 | = 25,000 |
| Water and Electricity facilities | = 20,000 |
| Landscaping | |
| $500 x 75 acres | = 375,000 |
| SUBTOTAL | $550,000 |
| Cost Peculiar to North | |
| road costs | = 100,000 |
| Cost Peculiar to South | |
| extra landscaping | = 100,000 |
| TOTAL COST for either $550,000 + $100,000 | = 650,000 |
| Yearly Operating Expenses | |
| Additional administrative cost to Park Department | = 12,000 |
| Life guards, grounds keepers, etc. | = 110,000 |
| Gas, oil, and depreciation of lawnmowers, etc. | = 8,000 |
| TOTAL | = 130,000 |

3. **Equation for $P_3$ in Table 3**

$$P_3 = \frac{1}{.31025} \left( \frac{650}{X} + .130 \right)$$

.31025 is attendence in millions

.65 is construction cost in millions

.130 is operating cost in millions

X is as defined in Appendix 1

4. Equation for $P_4$ in Table 3.

$$P_4 = \frac{1}{X} \left( \frac{1}{.31025} \right)$$

* Estimated with the help of:
William Rosenberg
Landscape Architect



**TABLE 1**

| | | 6% | 8% | 10% | 12% | 14% |
|---|---|---|---|---|---|---|
| 20 Year Project Starting Immediately M = 1 N = 20 | PVB (in millions) | \$8.090 | \$6.917 | \$5.982 | \$5.244 | \$4.653 |
| | NB (in millions) | 5.365 | 4.192 | 3.257 | 2.519 | 1.928 |
| | $P_1$ | .63 | .74 | .85 | .98 | 1.09 |
| | $P_2$ | 4.22 | 4.62 | 5.05 | 5.51 | 5.97 |
| 10 Year Project Starting Immediately M = 1 N = 10 | PVB (in millions) | 5.202 | 4.717 | 4.319 | 3.971 | 3.666 |
| | NB (in millions) | 2.477 | 1.992 | 1.594 | 1.246 | 1.941 |
| | $P_1$ | .98 | 1.09 | 1.18 | 1.29 | 1.39 |
| | $P_2$ | 5.53 | 5.91 | 6.29 | 6.67 | 7.08 |
| 10 Year Project Starting 5 Years in the Future M=6 N=15 | PVB (in millions) | 4.097 | 3.466 | 2.950 | 2.523 | 2.170 |
| | NB (in millions) | 1.372 | .741 | .225 | -.202 | -.555 |
| | $P_1$ | 1.25 | 1.48 | 1.73 | 2.03<br>(7.40) | 2.36<br>(8.30) |
| | $P_2$ | 6.53 | 7.38 | 8.34 | 9.43 | 10.66 |
| 10 Year Project Starting 10 Years in the Future M=11 N=20 | PVB (in millions) | 2.889 | 2.200 | 1.664 | 1.272 | .988 |
| | NB (in millions) | .164 | -.525 | -1.061 | -1.453 | -1.737 |
| | $P_1$ | 1.77 | 2.33<br>(8.22) | 3.08<br>(10.26) | 4.04<br>(12.86) | 5.19<br>(16.02) |
| | $P_2$ | 8.48 | 10.55 | 13.34 | 16.90 | 21.21 |

$P_1$ is the increase in price necessary to make the water based facility have a net benefit \$1 million greater than the land based facility to make up for the extra construction costs in those projects. See Item 5 in Appendix 1.

$P_2$ is theprice necessary for the water based facility to have net benefits of \$1 million. See item 6 in appendix 1.

M andN are defined in Appendix 1.

TABLE 2

| | | 6% | 8% | 10% | 12% | 14% |
|---|---|---|---|---|---|---|
| 20 Year Project Starting Immediately | $P_3$ | $.60 | $.63 | $.66 | $.70 | $.73 |
| | $P_4$ | .28 | .32 | .38 | .43 | .49 |
| M = 1 N = 20 | TOTAL | .88 | .95 | 1.04 | 1.13 | 1.22 |
| 10 Year Project Starting Immediately | $P_3$ | .70 | .73 | .76 | .79 | .82 |
| | $P_4$ | .43 | .48 | .52 | .57 | .61 |
| M = 1 n = 10 | TOTAL | 1.13 | 1.21 | 1.28 | 1.36 | 1.43 |
| 10 Year Project Starting 5 years in the Future | $P_3$ | .78 | .84 | .92 | 1.00 | 1.10 |
| | $P_4$ | .55 | .65 | .76 | .90 | 1.04 |
| M = 6 N = 15 | TOTAL | 1.33 | 1.49 | 1.68 | 1.900 | 2.14 |
| 10 Year Project Starting 10 years in the Future | $P_3$ | .93 | 1.08 | 1.30 | 1.57 | 1.91 |
| | $P_4$ | .78 | 1.03 | 1.36 | 1.78 | 2.29 |
| M = 11 N = 20 | TOTAL | 1.71 | 2.11 | 2.66 | 3.35 | 4.20 |

$P_3$ = price necessary for benefits to be equal to cost (see appendix 2, item 3)

$P_4$ = increase in price necessary to make net benefits equal to $7 million. (see appendix 2, item 4)



TABLE 3

| | (in millions) | 6% | 8% | 10% | 12% | 14% |
|---|---|---|---|---|---|---|
| 20 Year Project | $PVB_{225}$ | $6.538 | $5.589 | $4.836 | $4.237 | $3.762 |
| Starting Immediately | $NB_{225}$ | 5.888 | 4.939 | 4.186 | 3.587 | 3.112 |
| M=1 | $PVB_{75}$ | 1.181 | 1.010 | .874 | .766 | .680 |
| N=20 | $NB_{75}$ | .531 | .360 | .224 | .116 | .030 |
| 10 Year Project | $PVB_{225}$ | 4.203 | 3.811 | 3.490 | 3.209 | 2.963 |
| Starting Immediately | $NB_{225}$ | 3.553 | 3.161 | 2.840 | 2.559 | 2.313 |
| M=1 | $PVB_{75}$ | .759 | .689 | .631 | .580 | .535 |
| N=10 | $NB_{75}$ | .109 | .039 | -.019 | -.07 | -.115 |
| 10 Year Project | $PVB_{225}$ | 3.311 | 2.801 | 2.384 | 2.039 | 1.754 |
| Starting 5 years in | $NB_{225}$ | 2.661 | 2.151 | 1.734 | 1.389 | 1.104 |
| the Future | $PVB_{75}$ | .598 | .506 | .430 | .368 | .317 |
| M=6 | $NB_{75}$ | -.052 | -.144 | -.220 | -.282 | -.333 |
| N=15 | | | | | | |
| 10 Year Project | $PVB_{225}$ | 2.334 | 1.778 | 1.345 | 1.028 | .798 |
| Starting 10 years in | $NB_{225}$ | 1.684 | 1.128 | .695 | .378 | .148 |
| the Future | $PVB_{75}$ | .422 | .321 | .243 | .185 | .144 |
| M=11 | $NB_{75}$ | -.228 | -.329 | -.407 | -.465 | -.506 |
| N=20 | | | | | | |

$PVB_{225}$ and $NB_{225}$ are the present value of the benefits and the net benefit for a picnic facility built to the north of the existing plant with a hypothesized value per use day of $2.25

$PVB_{75}$ and $NB_{75}$ represent the same for a picnic facility built to the south with no access to the water and a hypothesized value per user day of $0.75

## References

Cicchetti, C. J., et al., Benefits or Costs? An Assessment of the Water Resources Council's Proposed Principles and Standards March, 1972, Department of Geography and Environmental Engineering, the Johns Hopkins University , Baltimore, Maryland 21218

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## Acknowledgements

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